CORNEY BAYOU TMDL FOR DISSOLVED OXYGEN

May 28, 2002

CORNEY BAYOU TMDL
FOR DISSOLVED OXYGEN

SUBSEGMENT 080607

Prepared for

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources (NPS) discharging to the waterbody. This report presents a TMDL that has been developed for dissolved oxygen (DO) for Corney Bayou (subsegment 080607) in the Ouachita River basin in northern Louisiana.

Subsegment 080607 was not included on either the 1998 303(d) List for Louisiana or the Modified Court Ordered 303(d) List for Louisiana. However, field data collected by the Louisiana Department of Environmental Quality (LDEQ) during 1999 indicated that this subsegment was not fully supporting its designated use of propagation of fish and wildlife. The water quality standard for DO in this subsegment is 5 mg/L year round.

A water quality model (LA-QUAL) was set up to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen in the subsegment. The model was set up and calibrated using LDEQ assessment data collected during January through December 1999, observations from a synoptic survey conducted by FTN Associates, Ltd. (FTN) during August 2001, and other various information obtained from LDEQ, Arkansas Department of Environmental Quality (ADEQ), and U.S. Geological Survey (USGS). There were no intensive survey data available for this subsegment. The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing NPS loads were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

A TMDL for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand (SOD)) was calculated using the results of the projection simulation. Both implicit and explicit margins of safety (MOS) were included in the TMDL calculations. The results of the modeling and TMDL calculations showed that NPS loads will need to be reduced by approximately 91% to meet the DO standard of 5 mg/L in subsegment 080607.

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1.0 INTRODUCTION

This report presents a total maximum daily load (TMDL) for dissolved oxygen (DO) for Corney Bayou, which is subsegment 080607. This subsegment was not listed on either the 1998 303(d) List for Louisiana (LDEQ 1998) or the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000). However, field data collected by the Louisiana Department of Environmental Quality (LDEQ) during 1999 show that the designated use of propagation of fish and wildlife is not being fully supported due to low DO values. Therefore, a TMDL for DO is required for this subsegment. The TMDL in this report was developed in accordance with Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

2.0 STUDY AREA DESCRIPTION

2.1 General Information

Corney Bayou (subsegment 080607) is located approximately 30 miles northwest of Ruston, LA in the Ouachita River basin (see Figure A.1 in Appendix A). The Arkansas State line forms the northern boundary of the subsegment (see Figure A.2). This subsegment receives drainage from more than 200 mi^2 of upstream area in Arkansas (USGS 1971). The main stem of Corney Bayou extends approximately 14 miles from the Arkansas State line downstream to the edge of the Corney Lake subsegment. Most of the Corney Bayou subsegment is forested and sparsely populated. Land use for this subsegment is shown in Table 2.1.

Table 2.1. Land uses in subsegment 080607 based on GAP data (USGS 1998).

Land Use Type	% of Total Area
Fresh Marsh	0.0%
Saline Marsh	0.0%
Wetland Forest	19.5%
Upland Forest	60.0%
Wetland Scrub/Shrub	0.8%
Upland Scrub/Shrub	12.8%
Agricultural	3.9%
Urban	0.0%
Water	2.8%
Barren Land	0.2%
TOTAL	100.0%

2.2 Water Quality Standards

The numeric water quality standards and designated uses for this subsegment are shown in Table 2.2. The primary numeric standard for the TMDL presented in this report is the DO standard of 5 mg/L year round.

Table 2.2. Water quality standards and designated uses (LDEQ 2000a).

Subsegment Number	080607
Waterbody Description	Corney Bayou From Arkansas State Line to Corney Lake (Scenic)
Designated Uses	ABCG
Criteria:	
Chloride	160 mg/L
Sulfate	25 mg/L
DO	5 mg/L (year round)
pH	6.0-8.5
Temperature	32 °C
TDS	300 mg/L

USES: A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

2.3 Identification of Sources

2.3.1 Point Sources

A listing of all NPDES permits in the Ouachita and Calcasieu River basins was searched to identify any permits within the Corney Bayou subsegment (080607). This listing was prepared by EPA Region 6 using databases and permit files from LDEQ. Based on this listing, no NPDES permits were identified within subsegment 080607. Therefore, no point sources were included in the model or TMDL calculations for this subsegment.

2.3.2 Nonpoint Sources

For subsegment 080607 there is no 303(d) listing citing suspected sources of impairment for water quality. However, there are 303(d) listings for two nearby subsegments that are similar (080609 - Corney Bayou downstream of Corney Lake, and 080610 - Middle Fork Bayou D'Arbonne). The listings for both of these subsegments indicate impairments due to "Other", "Natural sources", and "Unknown source".

2.4 Previous Data and Studies

Listed below are previous water quality data and studies in or near the Corney Bayou subsegment. The locations of the LDEQ and Arkansas Department of Environmental Quality (ADEQ) monitoring stations are shown on Figure A.2 (in Appendix A).

1. Monthly data collected by LDEQ for "Corney Bayou Northwest of Summerfield, Louisiana" (Station 0782) for January to December 1999. Although the name and sampling site description suggest that data were collected within the subsegment, communication with LDEQ regional office personnel indicate that data for this station were actually collected at the Highway 9 bridge near the upstream end of Corney Lake (as shown in Figure A.2).

2. Data collected by ADEQ for "Cornie Bayou near Three Creeks" (Station OUA02) for 1968 to present.

3. Data collected by US Geological Survey (USGS) for "Corney Bayou near Arkansas-LA State Line" (Station 07365830) on 15 different dates between 1956 and 1969. This station is located within subsegment 080607, but the data are mostly mineral analyses and do not include any measurements of DO or biochemical oxygen demand (BOD).

3.0 CALIBRATION OF WATER QUALITY MODEL

3.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (version 4.13), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, ultimate carbonaceous biochemical oxygen demand (CBODu), and DO.

3.2 Calibration Period and Calibration Targets

An intensive field survey was not performed for the study area due to schedule and budget limitations. A synoptic survey of the study area was performed by FTN in August 2001, but the field crew could not collect data in the main stem of Corney Bayou within subsegment 080607 due to restricted access (a road was blocked). The only historical period for which relevant water quality data were collected for this subsegment was the January through December 1999 period when LDEQ collected their assessment data at station 0782.

The water quality data for this period were retrieved from the LDEQ website. These data are shown in Appendix B. The two conditions that usually characterize critical periods for DO are high temperatures and low flows. High temperatures decrease DO saturation values and increase rates for oxygen demanding processes (BOD decay, nitrification, and sediment oxygen demand (SOD)). In most systems, low flows cause reaeration rates to be lower. The purpose of selecting a critical period for calibration is so that the model will be calibrated as accurately as possible for making projection simulations for critical conditions.

Based on the LDEQ data in Appendix B, the calibration period was selected as July 21 to September 21, 1999. This period represented the most critical period for DO. The calibration target (i.e., the concentration to which the model was calibrated) for each parameter was set to the average of the concentrations measured during the calibration period. The LDEQ routine monitoring data did not include carbonaceous biochemical oxygen demand (CBOD), but there were measurements of total organic carbon (TOC). Therefore, the calibration target for CBODu was estimated from the TOC data based on statistics from LDEQ's long term BOD analyses. The LDEQ's long term BOD analyses consisted of 140 samples from intensive surveys in the Ouachita River basin during 2001. These samples were analyzed for numerous parameters including CBODu and TOC. The ratio of CBODu to TOC was calculated for each sample and the median of those 140 ratios was determined to be 1.10. Using this result, the CBODu calibration target was estimated as 1.10 times the average TOC during the calibration period. Data from the LDEQ long term BOD analyses are shown in Appendix C.

3.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the "LTP"; LDEQ 2001). These correction factors were:

• Correction for BOD decay:	1.047 (value in LTP is same as model default)
• Correction for SOD:	1.065 (value in LTP is same as model default)
• Correction for ammonia N decay:	1.070 (specified in Data Group 4)
• Correction for organic N decay:	1.020 (not specified in LTP; model default used)
• Correction for reaeration:	automatically calculated by the model

3.4 Hydraulics (Data Type 9)

The hydraulics were specified in the input for the LA-QUAL model using the power functions (width = a * Q^b + c and depth = d * Q^e + f). The parameters for the power functions were based upon log-log regressions of data from individual discharge measurements made by USGS personnel at the gaging station on Corney Bayou near Three Creeks, Arkansas (07365800; same location as ADEQ station OUA02 on Figure A.2). These data are shown in Appendix D and consist of width, cross sectional area, and mean velocity for individual discharge measurements that were taken over a wide range of flows for developing and maintaining a rating curve. Mean depth for each discharge measurement was calculated as cross sectional area divided by width. Plots of width, depth, and velocity versus flow were developed in a spreadsheet and trendlines were put on the plots to show the regression results. These plots and regression results are shown in Appendix D. Model input values for the calibration are shown in Appendix E.

3.5 Initial Conditions (Data Type 11)

Because temperature is not being simulated in the model, temperature for each reach was specified in the initial conditions for LA-QUAL. The temperature for each reach was set to 25.0°C, which was the average temperature measured at station 0782 during the calibration period. The input data and sources are shown in Appendix E.

For constituents not being simulated, the initial concentrations were set to zero; otherwise, the model would have assumed a fixed concentration of those constituents and the model would have included the effects of the unmodeled constituents on the modeled constituents (e.g., the effects of algae on DO).

3.6 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in LA-QUAL include reaeration rates, CBOD decay rates, nitrification rates, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix E.

For reaeration, the Louisiana Equation (option 15) was specified in the model because it was developed specifically for streams in Louisiana and it has been used successfully in the past for other TMDLs in Louisiana.

The rates for CBOD decay and nitrification (ammonia nitrogen "decay") were based on median values of laboratory decay rates from LDEQ's long term BOD analyses. The LDEQ long term BOD analyses consisted of 140 samples from intensive surveys in the Ouachita River basin during 2001. The median decay rates for CBOD and nitrogenous biochemical oxygen demand (NBOD) were approximately 0.06/day and 0.07/day, respectively. These data are shown in Appendix C. Because instream decay rates are typically slightly higher than laboratory decay rates, both the CBOD decay rates and the nitrification rates were set to 0.10/day for all reaches.

The mineralization rates (organic nitrogen decay) in the model were set to 0.02/day for all reaches. This value was similar to the values shown in Table 5.3 of the "Rates, Constants, and Kinetics" publication (EPA 1985) for dissolved organic nitrogen being transformed to ammonia nitrogen. The literature values for mineralization rates are shown in Appendix F.

One other input value was specified for characterizing the nitrification process. In the program constants section of the model input file (data type 3), the nitrification inhibition option was set to 1 instead of the default of option number 2. With the default option, the nitrification rate drops rapidly when the DO drops below 2 mg/L, which results in an unrealistic build up of ammonia nitrogen at low DO. Option number 1 provides nitrification inhibition that is similar to what is simulated in other widely used water quality models such as QUAL2E and WASP (see Figure 3.5 in FTN 2000).

3.7 Nonpoint Source Loads (Data Type 19)

The NPS loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBOD loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia source rates (specified in data type 13), and the mass loads of organic nitrogen and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The values used as model input are shown in Appendix E.

These four calibration parameters were adjusted in a specific order based on the interactions between state variables in the model. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables will affect the organic nitrogen concentrations. Next, the benthic ammonia source rates were adjusted until the predicted ammonia nitrogen concentrations were similar to the observed concentrations. Then the CBODu loads were adjusted until the predicted CBODu concentrations were similar to the observed concentrations. Finally, the SOD rates were adjusted until the predicted DO concentrations were similar to the observed concentrations. The DO was calibrated last because all of the other state variables affect DO.

3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24)

Inflows in the model were specified for the headwater (Corney Bayou at the state line) and for two tributaries (Little Corney Bayou and Three Creeks). Because the USGS gaging station for Corney Bayou near Three Creeks, Arkansas (07365800) was discontinued in the late 1980's, USGS flow data from a nearby stream were used to estimate inflows for Corney Bayou. The inflow rates for the model were based on the average of the USGS daily flow data for Little Corney Bayou near Lillie, LA (07366200) during the calibration period (July 21 to September 21, 1999). These flow data are shown in Appendix G. This gage is located approximately 8 miles southeast of Junction City in a watershed that is similar to subsegment 080607 (it is on a different Little Corney Bayou than the one that flows into Corney Bayou within subsegment 080607). The average flow at this gaging station during the calibration period (3.28 cfs) was divided by the drainage area at the gage (208 mi^2) to obtain an estimated flow per unit area (0.0158 cfs per mi^2). The flow rate for the headwater and each tributary was then obtained by multiplying this flow per unit area times the appropriate drainage area. The drainage area for the headwater was obtained directly from a drainage area report for Louisiana (USGS 1971). Over 85% of the remaining area draining into Corney Bayou within subsegment 080607 enters Corney Bayou through the two tributaries (Little Corney Bayou and Three Creeks). Therefore, the drainage area assigned to each of these two tributaries was calculated by subtracting the headwater drainage area from the drainage area at the downstream end of the subsegment and dividing it in half. The drainage area information and inflow calculations are shown in Appendix G.

3.9 Headwater and Tributary Water Quality (Data Types 20, 21, 24 and 25)

Concentrations of DO, CBODu, organic nitrogen, and ammonia nitrogen were specified in the model for the headwater and both tributaries. Water quality for the headwater was set to the average concentrations measured at ADEQ station OUA02 during the calibration period. The data at station OUA02 were also considered to be representative of other inflows to Corney Bayou. Therefore, the concentrations for each tributary were set to the same as the headwater values. The BOD_5 values in the ADEQ data set were converted to CBODu values by multiplying them by 3.94, which was the median ratio of CBODu to $CBOD_5$ from the LDEQ long term BOD analyses (shown in Appendix C). The values used as model input are shown in Appendix E.

3.10 Point Source Inputs (Data Types 24 and 25)

As discussed in Section 2.3.1, no NPDES permits were identified within subsegment 080607. Therefore, no point source discharges were included in the model.

3.11 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix H and a printout of the LA-QUAL output file is included as Appendix I. The calibration was considered to be acceptable based on the amount of data that were available.

4.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

4.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of a MOS in the development of a TMDL. For the TMDL in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit MOS was used in developing the projection model.

Critical conditions for DO have been determined for Louisiana streams in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cfs, whichever is higher, for all headwaters, and 90th percentile temperature for the summer season. Model loading is from perennial tributaries, SOD, and resuspension of sediments.

In reality, the highest temperatures occur in July-August and the lowest stream flows occur in October-November. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yields an implicit MOS that is not quantified. Over and above this implicit MOS, an explicit MOS of 10% for NPS was incorporated into the TMDL in this report to account for model uncertainty.

4.2 Temperature Inputs

The LTP (LDEQ 2001) specified that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled. Because the LDEQ station for Corney Bayou has only 12 months of data, LDEQ data from another subsegment were used for this analysis. Long term temperature data from Bayou de L'Outre near Monroe, Louisiana (LDEQ station 0072) were used to calculate a 90^{th} percentile summer temperature of 29.0EC. However, the water temperatures for Bayou de L'Outre were slightly warmer (2.7EC) than the temperatures in Corney Bayou for the same period. This difference was subtracted from the 90^{th} percentile temperature for Bayou de L'Outre to yield a critical temperature of 26.3EC for Corney Bayou. This value was specified in Data Type 11 in the model and is shown in Appendix J along with other inputs that were changed from the calibration to the projection. The 90^{th} percentile temperature calculations are shown in Appendix K.

Because Corney Bayou has a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

4.3 Headwater and Tributary Inputs

The inputs for the headwaters and tributaries for the projection simulation were based on guidance in the LTP. As specified in the LTP, the DO concentration for the headwater and tributary inflows was set to 90% saturation at the critical temperature. Headwater and tributary concentrations for other parameters were kept at the calibration values.

The published 7Q10 flow for Corney Bayou near Three Creeks, Arkansas is zero (gage number 07365800; USGS 1992). This gage was at the same location as ADEQ station OUA02 on Figure A.2. The LTP specifies that the critical flow rate for summer should be set to the 7Q10 flow or 0.1 cfs, whichever is higher. Therefore, the headwater flow rate in the projection simulation was set to 0.1 cfs. Based on the drainage area sizes, the 7Q10 flow rate for each of the two tributaries (Little Corney Bayou and Three Creeks) was assumed to be zero. Therefore, the inflow rate for each of the two tributaries was set to 0.1 cfs. The values used as model input in the projection simulation are shown in Appendix J. The published 7Q10 information is shown in Appendix L.

4.4 Point Source Inputs

As discussed in Section 2.3.1, no NPDES permits were identified within subsegment 080607. Therefore, no point source discharges were included in the model.

4.5 Nonpoint Source Loads

Because the initial projection simulation showed low DO values, the NPS loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. The same percent reduction was applied to all components of the NPS loads (SOD, benthic ammonia source rates, and mass loads of CBODu and ammonia nitrogen). The values used as model input in the projection simulation are shown in Appendix J.

4.6 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 4.2 – 4.6. Other model inputs (e.g., hydraulic and dispersion coefficients, decay rates, reaeration equations, etc.) were unchanged from the calibration simulation.

4.7 Model Results for Projection

A plot of predicted DO for the projection is presented in Appendix M and a printout of the LA-QUAL output file is included as Appendix N.

A NPS load reduction of approximately 91% was required to bring the predicted DO values to at least 5.0 mg/L. This percentage reduction for NPS loads represents a percentage of the entire NPS loading, not a percentage of the manmade NPS loading. The NPS loads in this report were not divided between natural and manmade because it would be difficult to estimate natural NPS loads for the study area.

5.0 TMDL CALCULATIONS

5.1 DO TMDL

A total maximum daily load (TMDL) for DO has been calculated for the Corney Bayou subsegment based on the results of the projection simulation. The DO TMDL is presented as oxygen demand from CBODu, organic nitrogen, ammonia nitrogen, and SOD. A summary of the loads for Corney Bayou is presented in Table 5.1.

The TMDL calculations were performed using a FORTRAN program that was written by FTN personnel. This program reads two files; one is the LA-QUAL output file from the projection simulation and the other is a small file with miscellaneous information needed for the TMDL calculations (shown in Appendix O). The output from the program is shown in Appendix P and the source code for the program is shown in Appendix Q.

Table 5.1. DO TMDL for Subsegment 080607 (Corney Bayou).

	Oxygen demand (kg/day) from:				**Total oxygen demand (kg/day)**
	CBODu	**Organic N**	**Ammonia N**	**SOD**	
WLA for point sources	0	0	0	n/a	0
MOS for point sources	0	0	0	n/a	0
LA for all NPS	12.53	2.55	0.14	61.82	77.04
MOS for all NPS	1.39	0.28	0.02	6.87	8.56
Total maximum daily load	13.92	2.83	0.16	68.69	85.60

The oxygen demand from organic nitrogen and ammonia nitrogen was calculated as 4.33 times the nitrogen loads (assuming that all organic nitrogen is eventually converted to ammonia). The value of 4.33 is the same ratio of oxygen demand to nitrogen that is used by the LA-QUAL model. For the SOD loads, a temperature correction factor was included in the calculations (in order to be consistent with LDEQ procedures).

5.2 Ammonia Toxicity Calculations

Although subsegment 080607 is not on a 303(d) List for ammonia, the ammonia concentrations predicted by the projection model were checked to make sure that they did not exceed EPA criteria for ammonia toxicity (EPA 1999). The EPA criteria are dependent on temperature and pH. The water temperature used to calculate the ammonia toxicity criterion for Corney Bayou was the same as the critical temperature used in the projection simulation (26.3°C). For pH, an average of the values measured at LDEQ station 0782 during the calibration period was used. The resulting criterion was 3.1 mg/L of ammonia nitrogen. The instream ammonia nitrogen concentrations predicted by the LA-QUAL model (= 0.2 mg/L) were well below the criterion. This indicates that the ammonia nitrogen loadings that will maintain the DO standard are low enough that the EPA ammonia toxicity criteria will not be exceeded under critical conditions. The ammonia toxicity calculations are shown in Appendix R.

5.3 Summary of NPS Reductions

In summary, the projection modeling used to develop the TMDLs above showed that NPS loads need to be reduced by 91% to maintain the DO standard in Corney Bayou.

5.4 Seasonal Variation

As discussed in Section 4.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the model accounts for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

5.5 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 4.1, the highest temperatures occur in July through August and the lowest stream flows occur in October through November.

The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS which is not quantified. In addition to the implicit MOS, the TMDL in this report includes an explicit MOS of 10% for NPS loads.

6.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. Therefore it is of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the LA-QUAL model to vary one input parameter at a time while holding all other parameters to their original value. The calibration simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 6.1. Each parameter was varied by "30%, except for temperature, which was varied "2ºC.

Values reported in Table 6.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration and SOD were the parameters to which DO was most sensitive.

Table 6.1. Summary of results of sensitivity analyses.

Input Parameter	**Parameter Change**	**Predicted minimum DO (mg/L)**	**Percent Change in Predicted DO (%)**
Baseline	-	2.44	N/A
Dispersion	+30%	2.44	<1
Dispersion	-30%	2.44	<1
NH3 decay rate	-30%	2.44	<1
Organic N decay rate	+30%	2.44	<1
Organic N decay rate	-30%	2.44	<1
Waste Load BOD	+30%	2.44	<1
Waste Load BOD	-30%	2.44	<1
Waste Load DO	+30%	2.44	<1
Waste Load flow	+30%	2.44	<1
Waste Load NH3	+30%	2.44	<1
Waste Load NH3	-30%	2.44	<1
Waste Load Organic N	+30%	2.44	<1
Waste Load Organic N	-30%	2.44	<1
NH3 decay rate	+30%	2.43	<1
Velocity	+30%	2.45	<1
BOD decay rate	+30%	2.41	1
BOD decay rate	-30%	2.47	1
Waste Load DO	-30%	2.39	2
Depth	+30%	2.32	5
Waste Load Flow	-30%	2.16	11
Velocity	-30%	1.99	18
Headwater flow	+30%	2.93	20
Initial Temperature	+2EC	1.90	22
Headwater flow	-30%	1.85	24
SOD (Benthal)	+30%	1.73	29
Initial Temperature	-2EC	3.22	32
Depth	-30%	1.61	34
Reaeration	-30%	1.60	34
Reaeration	+30%	3.74	53
SOD (Benthal)	-30%	4.00	64

Note: Because there were no point source discharges in this model, "Waste Load" parameters are actually tributary parameters.

7.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:IX.1109.A).

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) List of impaired waters. This information is also utilized in establishing priorities for the LDEQ NPS program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) List. The sampling schedule for the first five-year cycle is shown below. The Ouachita River Basin will be sampled again in 2004.

1998 – Mermentau and Vermilion-Teche River Basins
1999 – Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors.

8.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, 40 CFR §130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999 Court Order, this TMDL was prepared under contract to EPA. After development of the draft of this TMDL, EPA commenced preparation of a notice seeking comments, information, and data from the general and affected public. Comments and additional information were submitted during the public comment period and this TMDL was revised accordingly. Responses to these comments and additional information are included in Appendix S. EPA has transmitted this revised TMDL to LDEQ for incorporation into LDEQ's current water quality management plan.

9.0 REFERENCES

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APPENDIX A THROUGH R AVAILABLE THROUGH EPA UPON REQUEST

APPENDIX S

Responses to Comments

COMMENTS AND RESPONSES
CORNEY BAYOU TMDL FOR DO
May 28, 2002

EPA appreciates all comments concerning this TMDL. Comments that were received are shown below with EPA responses or notes inserted in a different font.

GENERAL COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ):

Note: LDEQ submitted one document containing comments on 98 TMDLs for various pollutants and subsegments throughout the Ouachita and Calcasieu basins. Only the portions of that comment document that apply to the DO and nutrient TMDLs in the Ouachita basin (10 subsegments) are shown below. Some of the general comments may not apply to this report.

The Louisiana Department of Environmental Quality hereby submits comments on the 98 TMDLs and the calculations for these TMDLs prepared by EPA Region 6 for waters listed in the Calcasieu and Ouachita river basins, under section 303(d) of the Clean Water Act. Listed below are general comments.

1. Many of these TMDLs are based on models using historical water quality data gathered at a single or small number of locations rather than survey data gathered at sites spaced throughout the waterbody. The hydraulic information used was generally an average value or estimated value, not taken at the same time as the water quality data. The calibrations are inadequate due to the lack of appropriate hydrologic data and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

Response: The TMDLs were based on existing data plus information that could be obtained with available resources. Each model was developed using the most appropriate hydraulic information and water quality data that were available. A rationale was provided for data use and assumptions and limitations were given. Although LDEQ typically collects more data for model calibration than what was available for calibration of most of these models, EPA considers these model calibrations and the resulting TMDLs to be valid.

2. LDEQ does not consider any of these waters to be impaired due to low dissolved oxygen, nutrients, or ammonia. Many of these waters simply have inappropriate standards and criteria. The resources spent on developing these TMDLs could have been far more effectively and wisely spent on reviewing, approving, and assisting in the development of appropriate standards and criteria for these waters through the UAA process.

Response: TMDLs were developed for these subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the suspected causes of impairment (organic enrichment/low DO and/or nutrients) for each subsegment in the EPA Modified Court Ordered 303(d) List. TMDLs must be established to meet existing water quality standards. If it is determined that a standards changes is appropriate, the TMDL can be revised to reflect that change.

3. CBODu and NH3-N were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. The TMDL report uses the LDEQ's multi-basin loading database's median ratio values between the ultimate loads and the proposed surrogates. This data was based on the measured data from the last two years of LDEQ water quality surveys. LDEQ objects to the correlation of TOC to CBOD and NH3-N to TKN unless these correlations are taken from water quality data on the modeled waterbody. Our studies have shown only a moderate correlation between these parameters within the same waterbody, however when this correlation was attempted across waterbodies, extreme variability was seen and the correlations were not judged valid. It is possible that a combination of surrogates will obtain a better correlation, such as TOC along with color, turbidity, pH, etc. LDEQ is currently researching these options.

Response: EPA agrees that it would be ideal to have data collected from each modeled waterbody for relating TOC to CBOD and NH3-N to TKN. However, none of these subsegments had sufficient data from which these relationships could be developed. Relationships with surrogate parameters were used only when data for the desired parameter was not available.

4. BOD decay rates were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. The TMDL report uses the LDEQ's multi-basin loading database's median values. This data was based on the measured data from the last two years of LDEQ water quality surveys. It has been LDEQ's experience that these rates vary significantly from waterbody to waterbody and frequently vary significantly within the same waterbody. LDEQ objects to using surrogate data without regard for specific waterbody conditions for these parameters.

Response: Due to the schedule and level of resources available for this project, it was not feasible to perform long term BOD time series analyses on samples from these waterbodies. Given this situation, using LDEQ’s database was considered the best approach for estimating decay rates.

5. A winter projection model was not developed for most of the TMDLs. Winter projection models must be developed to address seasonality requirements of the Clean Water Act. Where point sources have seasonally variable effluent limitations or such seasonal variations are proposed, a winter projection model is required to show that standards are met year-round.

Response: As discussed in Section 4.2 of each report, summer is the most critical season for meeting the year round standard for DO for these subsegments. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. The available information for point source discharges indicated that the facilities discharging to these waterbodies do not have seasonal permit limits. If any of these facilities wishes to pursue seasonal permit limits, then LDEQ or the permittee can re-run the model to develop seasonal wasteload allocations.

6. LDEQ takes exception to the calculation of a TMDL based on TN/TP ratios derived from waterbodies other than the modeled waterbody. It is LDEQ's experience that the natural allowable TN/TP ratio is waterbody-specific and can vary dramatically between streams.

Response: These nutrient TMDLs were developed using naturally occurring ratios of nitrogen to phosphorus based on Louisiana's narrative water quality standard for nutrients. These ratios were calculated using reference stream data rather than long term monitoring data for each subsegment because the reference stream data were considered to be more appropriate for naturally occurring conditions.

7. LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in these TMDLs. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site- specific conditions or species and may be inappropriately over protective or under protective. No ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in these TMDLs. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances.

Response: Ammonia toxicity calculations were performed to ensure that the ammonia loadings that will maintain DO standards will not cause any exceedences of the ammonia toxicity criteria. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia. EPA believes that this evaluation offers assurances that waters will continue to be free from the effects of toxic substances.

8. Algae were not simulated. Was there evidence that algae did not have an impact on the waterbody? Did the contractor have any Chlorophyll a measurements on which to base this determination?

Response: For most of these subsegments, the effects of algae were not simulated in the models because there were no data to clearly demonstrate a need for including algae and the models calibrated well without including algae (i.e., the models were calibrated without having to use unreasonable coefficients to compensate for algal effects).

SPECIFIC COMMENTS FROM LDEQ FOR CORNEY BAYOU:

1. Based upon a 91% reduction in loads and the fact that no point sources are located in this subsegment, these results suggest that a dissolved oxygen standard criteria change should be investigated. This was not noted in the report.

Response: The appropriateness of the DO standard was not mentioned in the report because the scope of this report was only the development of necessary TMDLs. Evaluation of the DO standard can be performed by LDEQ and documented in a separate report.

2. The margin of safety for both point sources and non-point sources should be 20%.

Response: The nonpoint margin of safety (MOS) was set to 10% based on other TMDLS on Louisiana waterbodies that have either been developed by LDEQ or approved by LDEQ. Eleven TMDL reports from LDEQ's website were reviewed to examine the explicit MOS for nonpoint sources. All 11 of these TMDLs were for oxygen demanding substances. The explicit MOS for nonpoint sources was set to 20% for 2 reports, 10% for 3 reports, and 0% for 6 reports. Therefore, the value of 10% was considered to be a typical value that was acceptable. However, EPA will consider this in future development of TMDLs in Louisiana.